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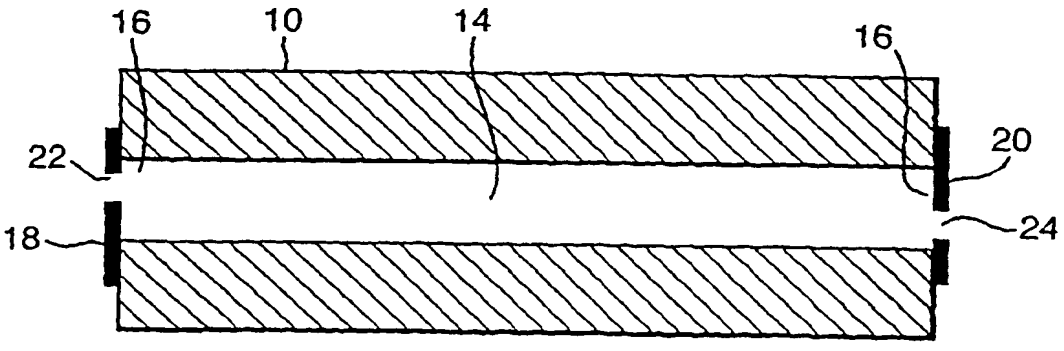
(54) Title: A METHOD OF PRODUCING A JOINT



(57) Abstract: The method comprises positioning two components (10, 12) adjacent each other so as to define a space between them, bridging edges (16) of the space (14) with webs (18, 20) and filling the space with flowable material (30) such as adhesive. A fabric (50) is preferably arranged in the space and is impregnated by the flowable material (30) as it is drawn into the space (14).

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to define a space between them, bridging edges of the space with a sealing member and filling the space with flowable material such as a resin adhesive by suction.

The method of the invention is particularly straightforward and assemblies made with it can be manufactured slightly under design tolerance with the difference being taken up within the filled space. In addition, the method of the invention allows only one preparation, assembly and cure cycle to be used.

The use of the sealing member not only helps to keep the material in place at the edges of the space but may also control the profile of the material at the edges.

The sealing member may comprise a web, and is preferably retained in its bridging position using a fixing means such as an adhesive coating on a side of the sealing web. The web may instead be held in place by laying it against the components and painting over it with a sealant, for example PR 1875 TM, an adhesive or a varnish. In the present example, the sealing web is constructed from fabric tape, although it may be constructed of other suitable material. The fabric tape may be constructed of glass or carbon fibres.

The components may be positioned adjacent each other using a construction jig.

It is desirable to have inlets at a low level and outlets at a high level to avoid resin/adhesive voids and porosity.

Paste adhesives are often used where the tolerances of the parts to be bonded are low but, even so, glue-lines (i.e. the thickness of the glue or adhesive layer between the components) greater than 0.5 mm have not previously been recommended using this method.

In order to address the problems that can arise with low tolerance components, a fabric of appropriate thickness may be placed in the space between the components prior to the filling of the space with the flowable material. That arrangement helps considerably to provide a strong joint line where the glue line is of substantial

each other so as to define a space between them with the projections extending into the space, and introducing a flowable material such as a resin adhesive into the space to surround the projections.

One of the components may have the projections thereon, although both the components may have projections. Where both components have projections it is preferable that the projections on one component interdigitate with the projections on the other component.

A method in accordance with the above aspects of the invention will now be described in detail, by way of example, and with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic cross-section of two aerospace components to be joined by a method in accordance with the invention,

Figure 2 shows the components of Figure 1 during the filling of the space with resin adhesive by suction,

Figure 3 shows the components of Figure 1 after the filling of the space with resin adhesive by suction,

Figure 4 is a diagrammatic cross-section of two alternative aerospace components to be joined by a method in accordance with the invention,

Figure 5 shows the components of Figure 1, with a fabric in the space between them, to be joined in a method in accordance with the invention,

Figure 6 shows the components of Figure 4, with a fabric in the space between them, to be joined in a method in accordance with the invention,

Figure 7 is a diagrammatic cross-section of two components with projections thereon to be joined in a method in accordance with the invention,

at a steady rate and minimises the chances of voids or porosity forming within the joint. Also the webs 18,20 control the profile of the resin 30 at the edges. In either case an effective and reliable bond is achieved.

Looking next a Figure 4, parts corresponding to parts shown in Figures 1 to 3 carry the same reference numerals. The component 12 extends beyond the edges of the component 10, and the space 14 between the components 10,12 is bridged by attaching webs 40,42 to an upper surface 44 and to the edges 45 of the component 10 and to an upper surface 46 of the component 12 as viewed in Figure 4. The webs 40,42 are constructed in the same way as webs 18,20 described above.

Once the components 10,12 and the webs 40, 42 are positioned as shown in Figure 4, a nozzle 26 is positioned in the inlet 24, a nozzle 28 is positioned in the outlet 28 and resin 30 is drawn into the space 14 as in Figures 2 and 3. It will be noted that the webs 40, 42 control the profile of the resin 30 at the edges. Again, as in Figures 1 to 3, the components 10, 12 can be held in position relative to each other by means of a construction jig. In this example a layer 47 of a release substance has been applied to the upper surface 46 of the component 12. This allows separation of the components 10, 12 after the joint has been formed. The release layer 47 may comprise a sealant material. If desired the two components 10, 12 can also be bolted together or otherwise mechanically joined together.

Referring now to Figure 5, parts corresponding to parts shown in Figures 1 to 4 carry the same reference numerals. First and second aerospace components 10,12 respectfully are positioned adjacent each other so as to define a space 14. Fabric 50 is then placed in the space 14 and edges 16 of the space 14 are bridged by means of sealing webs 18, 20. The sealing webs 18, 20 are again self-adhesive on one side. The resin is drawn into the space 14 in the manner described above so as to impregnate the fabric 50. Again, as in Figures 1 to 3, the components 10,12 can be held in position relative to each other by means of a construction jig.

If desired, a release layer 47 may be used in the embodiments of Figures 5 and 6.

Looking next at Figure 7, parts corresponding to parts shown in Figures 1 to 3 carry the same reference numerals.

The first and second components 10,12 respectively in Figure 7 have projections 60 thereon. The components 10,12 are positioned adjacent each other so as to define a space 14 between them with the projections 60 extending into the space 14 such that the projections on the first component 10 interdigitate with the projections on the second component 12. The two components 10, 12 are then joined using the method as described in Figures 1 to 3 during which the resin 30 surrounds the projections 60, the sealing webs 18, 20 are provided but not being shown in Figure 7.

In the present example the projections 60 are substantially straight, however, as shown in Figure 8 the projections 62 may be inclined.

The projections are preferably used where the glue-line exceeds 0.5 mm and are typically 1 - 3 mm in length. The projections provide an increase in shear strength to the joint.

Referring finally to Figure 9, first and second aerospace components 10, 12 with projections 60 thereon are positioned adjacent each other so as to define a space 14 between them with the projections 60 extending into the space 14 such that the projections interdigitate. A fabric 50 is placed in the space 14 and the two components are joined according to the method as described in Figures 1 to 3.

The joint formed in Figure 9 is of increased strength having both the benefits of the projections 60 and the fabric 50.

The joint formed by the method of the present invention may be rib-skin joints, stringer joints, skin-spar joints, hybrid joints and joints involving shimming.

Claims

1. A method of producing a joint, the method comprising positioning two components (10,12) adjacent each other so as to define a space (14) between them, bridging edges (16) of the space (14) with a sealing member (18,20) and filling the space (14) with a flowable material (30) such as an adhesive by suction.

2. A method according to claim 1 including placing a fabric (50) in the space (14) prior to filling the space with said flowable material (30).

3. A method of introducing a flowable material (30) such as adhesive between components (10,12), the method comprising positioning two components (10,12) adjacent each other so as to define a space (14) between them, placing a fabric (50) in the gap, and filling the space (14) with said flowable material (50), the edges (16) of the space (14) being bridged by a sealing member (18,20) prior to introduction of the flowable material (50).

4. A method according to claim 2 or 3 in which the fabric (50) occupies substantially 2 - 70 % of the space (14).

5. A method according to claim 4 in which the fabric (50) occupies substantially 30 - 60 % of the space (14).

6. A method according to any of claims 2 to 5 in which the fabric (50) comprises a lay-up of fibres such that fibres of one layer are transverse to fibres of another layer.

7. A method according to claim 6 in which the fabric (50) has a +/- 45 degree lay-up.

8. A method according to and preceding claim in which the sealing member (18,20) is in the form of a web.

between them with the projections (60) extending into the space (14), the flowable material (30) surrounding the projections (60) as it is introduced into the space (14).

19. A method of introducing a flowable material (30) such as adhesive between components (10,12), at least one of which has projections (60) thereon, the method comprising positioning two components (10,12) adjacent each other so as to define a space (14) between them with the projections (60) extending into the space (14), and bridging edges (16) of the space (14) with a sealing member (18,20) prior to introduction of the flowable material (30), the flowable material (30) surrounding the projections (60) as it is introduced into the space (14).

20. A method according to claim 18 or 19 in which projections (60) are provided on both components (10,12).

21. A method according to claim 18, 19 or 20 in which the projections (60) on one component (10,12) interdigitate with the projections (60) on the other component (10,12).

22. A method according to any of claims 18 to 21 in which the projections (60) are individual elements carried by the components (10,12).

23. A method according to any preceding claim in which the flowable material (30) is a paste-like adhesive, a resin, a sealant or a filler.

24. A method of introducing a flowable material (30) such as an adhesive between components (10,12), the method being substantially as described herein with reference to the accompanying drawings.

25. A joint comprising aerospace or other components (10,12), the joint being produced by a method according to any preceding claim.

Fig.1.

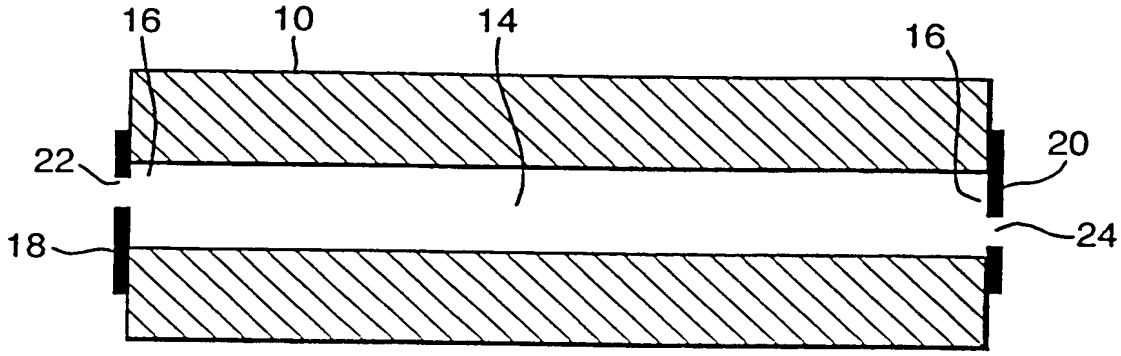


Fig.2.

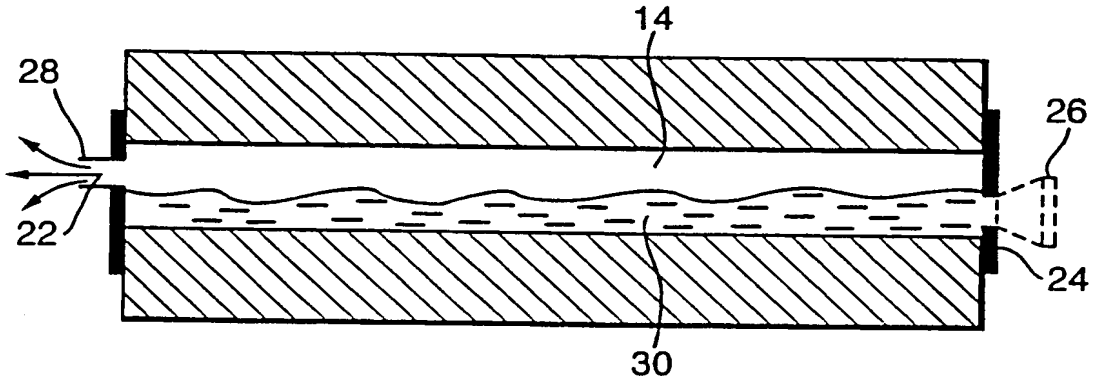


Fig.3.

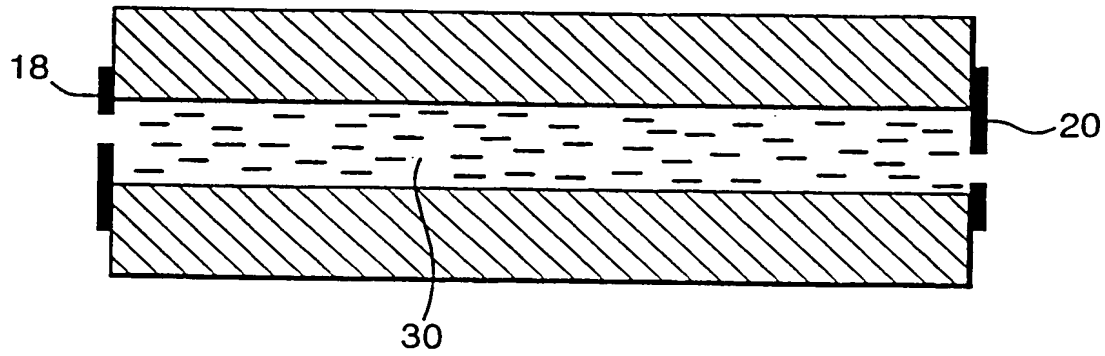


Fig.7.

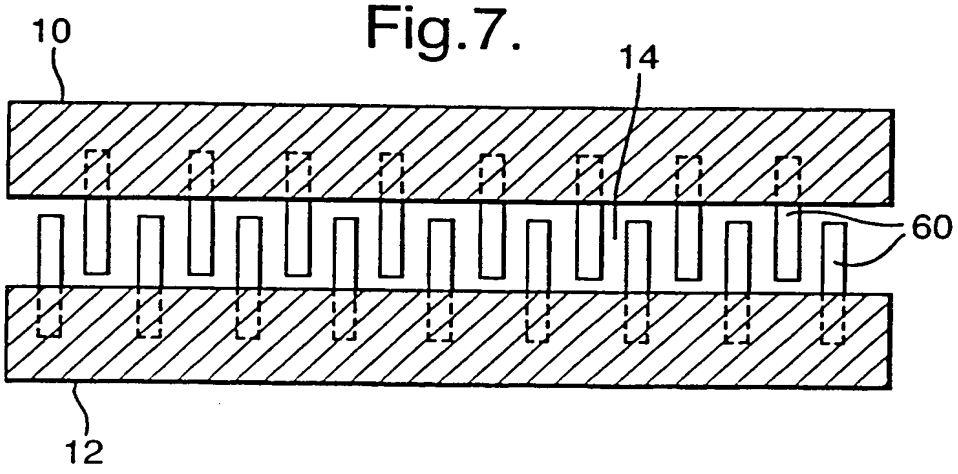


Fig.8.

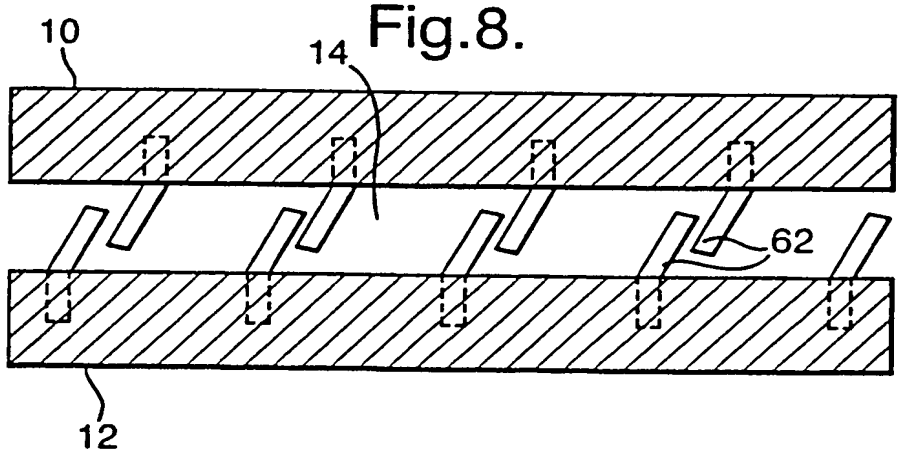
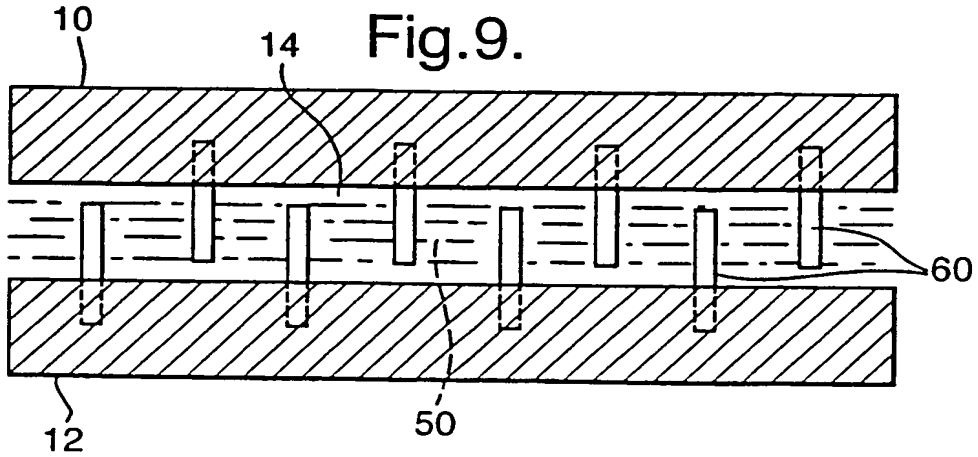


Fig.9.



C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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